INDOOR AIR QUALITY ASSESSMENT

James Leo McGuinness Administration Building
Lynn Public Schools
14 Central Avenue
Lynn, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
February, 2002

Background/Introduction

In response to a request from Edward Johns, Deputy Superintendent for the Lynn Public Schools (LPS), an indoor air quality assessment was done at the James Leo McGuinness Administration Building (JLMAB), 14 Central Avenue, Lynn, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). BEHA staff received complaints of headaches, coughs and respiratory irritation as well as other indoor symptoms that occupants believed to be attributed to the building.

The building was visited by Michael Feeney, Chief of BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program, and Cory Holmes, Environmental Analyst of the ER/IAQ Program, on December 18, 2001. Mr. Feeney returned to the building on January 17, 2002 to complete the assessment.

The JLMAB is a six-story office building located in downtown Lynn. The wedge-shaped footprint is bounded by Central Avenue on its north wall, Washington Street on its south wall and Oxford Street on its west wall (see Map). A three-story red brick building borders the east wall. The LPS has occupied the building for five years. The JLMAB was renovated in 1987 and prior to that, the building was reportedly unoccupied for a number of years. Private offices and work areas exist on floors 1, 3, 4, 5 and 6. Floor 2 contains the Lynn Environmental School that is used as the LPS alternative high school. The basement of the building contains mechanical rooms and is used for record storage. Sash windows in the building are openable, however in many cases occupants report that they do not operate or are difficult to open (see Tables). An elevator shaft is installed on the east wall of the building which transverses all floors from the 6th floor to the basement.

The building was evaluated by indoor air consultants and a government agency prior to the BEHA evaluation. In 1999, ATC Associates indicated that the rooftop air handling unit (AHU) had ill-fitting filters, degraded fiberglass insulation and a layer of dried biofilm on its floor (ATC, 1999). At that time, a roof leak on the 6th floor was noted and recommendations were made to repair it. The building was also evaluated by the Massachusetts Department of Labor and Workforce Development (MDLWD), Division of Occupational Safety in November, 2001, and a report was issued (MDLWD, 2001). The MDLWD report made the following recommendations:

1. Clean bird waste from space beneath the AHU.
2. Disinfect all areas on the roof contaminated with bird waste.
3. Have the AHU and ductwork professionally cleaned.
4. Service the AHU and change filters every three months.
5. Remove all water damaged ceiling tiles.
6. Establish cleaning schedule for occupied areas.
7. Vacuum carpets daily.
8. Remove water damaged box/cardboard from basement.
9. Have the carpets professionally cleaned twice a year.
10. Vacuum the basement with a vacuum cleaner equipped with a high efficiency particle arrestance (HEPA) filter.
11. Erect barrier on rooftop ventilation equipment to prevent bird roosting.
12. Clean efflorescence from foundation walls in basement and apply a waterproofing material.
13. Operate a dehumidifier in the basement.

Action on the majority of these recommendations should continue to be implemented, however further consideration should be given to recommendation #12. Waterproofing of foundation brickwork may result in a buildup of moisture within the cinderblock, creating a condition called subflorescence. This condition can result in accelerated breakdown of cinderblock materials. At this juncture, water damaged paint and efflorescence should be removed. Remediation steps concerning repair of the building's exterior wall system and exterior wall/sidewalk junction to prevent water penetration should be explored (see Recommendation section of this report).

The building management company, Reit Management & Research LLC (RMR), reported the following actions in response to the MDLWD recommendations:

1. Bird waste was cleaned from the roof areas.
2. A pest management contractor was hired.
3. A contractor was hired to install bird barriers.
4. A contractor was hired to adjust the ventilation system.
5. RMR is in the process of hiring an indoor air quality testing firm. (RMR, 2001).

At the time of the BEHA assessment, cleaning of the ductwork was reported by building occupants to be underway. Filter media was observed inside ceiling-mounted fresh air supply diffuser grilles to prevent dust penetration into occupied spaces.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

These offices have an employee population of approximately 70. Tests were taken under normal operating conditions and results appear in Tables 1-9. Air samples are listed by office occupant name.

Discussion

Ventilation

It can be seen from the tables that the carbon dioxide levels were below 800 ppm in all but three of seventy-three areas surveyed (see Tables), which indicates adequate ventilation exists in the majority of the building. Areas in the building are provided with fresh air by a heating, ventilation and air conditioning (HVAC) system powered by a rooftop AHU connected by ductwork to ceiling-mounted fresh air supply diffusers. By design, air diffusers are equipped with fixed louvers, which direct the air supply along the ceiling to flow down the walls, creating airflow.

Air is returned back to the rooftop AHU by a ceiling plenum system. Exhaust ventilation is provided by infiltration of air into an above ceiling plenum, which returns air to the AHU. This system has no ductwork, but uses the entire above ceiling space to draw air back to the AHU. Missing ceiling tiles in an open plenum return system compromise the efficiency of exhaust ventilation to remove stale air from the building.

The entire building was originally designed to have fresh air supplied by two roof-mounted AHUs (see Blueprint 1). In the original configuration, it appears that ductwork connected to "VAVU 1" provided fresh air for the basement area. Subsequent renovations appear to have replaced the original system with a single AHU. The original ductwork, however, remains in place, connected to the basement. If this ductwork draws air from the basement, pollutants present in the records storeroom (see Microbial/Moisture Concerns section of this report) can be drawn into the ventilation system and distributed to occupied areas of the building.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. In order to have proper ventilation with a mechanical supply and return system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was not available at the time of the assessment. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings recorded during the assessment ranged from 68 ^{o}F to 77 ^{o}F, which was close to the BEHA's recommended comfort range in most areas (see Tables). The BEHA recommends that indoor air temperatures be maintained in a range of 70 ^{o}F to 78 ^{o}F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Occupants expressed a number of complaints of uneven heating and cooling. As mentioned previously, fresh air supply diffusers have fixed louvers, which direct airflow along ceilings to ensure even distribution. Throughout the building, many of the air diffusers have louvers directed downwards (see Picture 1), which causes air to be directed straight down into the space, frequently on building occupants. In some areas, air diffusers were sealed with masking tape and/or cardboard in an effort to reduce cold air penetration. These alterations of the system can alter the airflow and balancing of the ventilation system, resulting in the creation of uneven heating/cooling conditions in other areas.

Relative humidity measurements ranged from 20 to 36 percent, which were below the BEHA comfort guidelines in all areas surveyed. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Humidity is more difficult to control during the winter heating season. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Three areas exist in the building by which water can enter and then either accumulate and/or moisten building or stored porous materials. These include the 6th floor roof/ceiling plenum junction, the elevator shaft and the exterior foundation wall in the basement records storage area. Materials that are susceptible to fungal growth when moistened exist in each area. The 6th floor elevator foyer has a well-documented water leak. Ceiling tiles appear to have been replaced. Of note is the presence of gypsum wallboard (GW) installed on the underneath side of the roof decking (see Blueprints 2 and 3). According to blueprints, GW was installed in this manner in the ceiling plenum to increase the fire rating of the building's structural materials. Water staining was noted along the seams of joined GW in the ceiling plenum (see Picture 2), indicating that water from the roof leak had passed through these seams to moisten ceiling tiles. GW is a material that is prone to fungal colonization. The GW side facing the roof in contact with water can result in chronic wetting, which can lead to fungal colonization of the GW paper. The US Environmental Protection Agency and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that GW be dried with fans and heating within 24 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If GW is not dried within this time frame, mold growth may occur. Water-damaged GW cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy GW is not recommended. Fungal microbial growth begins once water soaks porous materials. The fungus grows through its lifecycle, which produces spores. Dependent on the species of fungi, some spores are extremely buoyant and can be drawn into the ceiling plenum by operation of the ventilation system.

Signs of water damage also exist in the 4th and 5th floor elevator foyers. Water damaged ceiling tiles were observed around the west support pillar in each elevator foyer. Each pillar contains a steel-I-beam that is sealed within a GW box (see Blueprint 4). BEHA staff drilled a hole in the GW pillar-box on Floors 6, 5 and 4 to examine the interior surface of GW. I-beams were heavily corroded with rust. Water stains were noted on GW on each floor. GW and metal frames appeared to be covered on one surface with white, splotchy materials, which may be mold contamination. Each pillar-box appeared to draw GW dust created by drilling *into* each pillar, indicating that the pillars are open to the ceiling plenum of each floor. Spores from possible fungal contamination can also be drawn into the ceiling plenum. With poorly installed filters, these possible sources of microbial growth can be distributed to occupied areas of the building. Since this assessment, LPS officials reported that the repeated leak moistening the GW was traced to the roof of the elevator shaft. Efforts were reportedly made to repair the leak to prevent further water damage.

Several conditions exist in the building that indicate that water vapor and pollutants may be drawn up the elevator shafts to upper floors. In order to explain how basement air may be impacting the elevator lobbies on each floor, the following concepts concerning heated air and elevators must be understood.

1. Heated air will create upward air movement (called the stack effect).
2. Cold air moves to hot air, which creates drafts.
3. Airflow is created, intended or otherwise, from items that produce heat (e.g., fluorescent light bulbs).
4. As heated air rises, negative pressure is created, which draws cold air to equipment creating heat.
5. Airflow created by the stack effect, drafts or mechanical ventilation can draw particulates into the air stream.

Each of these concepts has influence on the movement of basement pollutants to the elevator foyers. As heated air rises in the elevator shaft, basement air can enter the elevator shaft. In addition to the stack effect, elevators can draw pollutants into the elevator shaft while cars operate. This piston effect can serve to place the basement elevator lobby under negative pressure as cars move upwards, which can then enhance the penetration of basement pollutants into occupied areas and hallways through doorframes and other holes in walls and ceilings.

BEHA staff noted standing water in the base of the elevator shaft. While the base of the elevator shaft had a sump pump connected to the building sewer system, the rate of water removal was not sufficient to dry the elevator shaft floor. Stagnant water indoors at the base of the elevator shaft can readily serve as a source for mold growth. Mold is a respiratory irritant. As reported by RMR personnel, a drain in the elevator shaft floor was clogged. According to LPS officials, the drain was reportedly repaired and efforts are underway to repair the elevator shaft to prevent further water intrusion.

The exterior of the building is a combination of original red brick above the first floor (see Picture 3), which transitions into a red granite slab system (see Picture 4). The seams of the granite slabs, as well as the sidewalk/granite slab junction, are filled with a sealant compound. The seams between granite slabs (see Picture 5) have shrunk or expanded to break the integrity of the seam. The sidewalk/granite slab seam also appears damaged (see Picture 5A) and in some areas, colonized with moss growth (see Picture 5B). The west corners of the building have granite slabs that are damaged, exposing the wall interior. All of these conditions can lead to water penetration into the basement through the foundation.

The Washington Street and Central Avenue exterior walls have breaks in slab sealant that correspond to areas on the first floor offices that have reported indoor air quality complaints. The area of the basement subjected to water penetration is used for equipment and record storage. In anticipation of possible water penetration through the foundation, an interceptor trench was cut into the floor (see Picture 6). Of note was the condition of foundation walls above the trench. Foundation walls show significant signs of efflorescence, with substantial amounts of paint peeled from the lowest section of the wall above the trench. As noted previously, waterproofing of foundation brickwork may actually result in degradation of the foundation wall through the buildup of moisture within the cinderblock, creating a condition called subflorescence. This condition can result in accelerated breakdown of cinderblock materials. Brick and mortar contain water and are readily penetrated by moisture. Thus, it is important to create conditions in the basement to allow for water penetrating through foundation walls to *dry as rapidly as* *possible*. The architects intended for the floor trench to intercept and collect water penetrating through foundation walls. This design did not presume that the basement would be subject to water penetration into an area that is used for record storage.

This area of the basement contains a substantial number of materials that may support mold growth including:

1. Paper records,
2. Cardboard boxes,
3. Debris in the drainage trench (see Picture 7);
4. Paint,
5. Pipe insulation,
6. Furniture and cloth floor dividers and
7. Ceiling tiles.

All of these materials can support mold growth if subjected to moisture. Of note is the condition of pipe insulation, which was found spotted with visible mold colonies (see Picture 8). The persistence of mold on pipe insulation, when considered with the condition of foundation paint and water in the elevator shaft indicate that moisture pathways exist in the basement. As with GW, if porous materials are not dried within 24 hours, mold growth may occur. Water-damaged porous materials (e.g., carpeting and pipe insulation) cannot be adequately cleaned to remove mold growth, unless extraordinary remediation measures are used. As previously discussed, the application of a mildewcide to porous materials is not recommended.

Two potential pathways exist for mold contamination to move from the basement to occupied areas of the building: holes in the basement ceiling and the building's HVAC system. The basement ceiling is penetrated by numerous holes for pipes, wires and other building utilities (see Pictures 9 and 10 as representative examples). These holes may serve as a pathway for basement pollutants to migrate into the first floor office area. The connection of the ventilation system may draw basement pollutants into the return system for the rooftop AHU. With poorly installed filters, these pollutants may be redistributed to occupied areas of the building.

Two wind-driven turbine fans exist on the roof, which appear to be part of the original exhaust ventilation system (see Blueprint 1, Picture 11). As reported by RMR staff, the installation of the rooftop AHU provides exhaust ventilation, thus rendering these vents obsolete. Since each of these vents can be a route for uncontrolled air/moisture to enter the building, sealing these vents may be advisable if they serve no purpose.

Several areas contained a number of plants. Plant soil, standing water and drip pans can be a potential source of mold growth. Drip pans should be inspected periodically for mold growth and over watering should be avoided. Plants should also be located away from fresh air diffusers to prevent aerosolization of dirt, pollen or mold.

Other Concerns

Several other conditions that can effect indoor air quality were noted during the assessment. In the telephone room of the basement is a shelf on which a number of batteries are stored (see Picture 12 and 12A). It was reported that these batteries were used as an emergency backup for the building's telephone system. This backup system is now reported by RMR to be obsolete. Corroded pipes and metal above the batteries may indicate they are leaking acid. The battery solution would be expected to be a dilute sulfuric acid solution. This mixture evaporates over time, which can form a vapor of sulfuric acid and water. Dilute sulfuric acid can be irritating to the eyes, nose and throat.

Conclusions/Recommendations

The conditions observed in the JLMAB are somewhat complicated. The leaking of water into the various parts of the building may have caused mold growth in GW used for fire rating purposes above ceilings. In addition, the accumulation of water in the elevator shaft and the connection of the ventilation system to the basement records storage area all provide a means for microbial growth to occur and to be distributed throughout the building.

A decision should be made concerning the mold-contaminated materials stored in the basement. These boxes, documents, books and other stored materials will continue to be a source of mold associated particulates. In this case, ventilation alone cannot serve to reduce or eliminate mold growth in these materials. As an initial step, options concerning the preservation of materials stored in this area should be considered. Since many of these materials appear to be historical records, an evaluation concerning disposition of these materials must be made. Porous materials that are judged not worthy of preservation, restoration or transfer to another media (e.g., microfiche or computer scanning) should be discarded. Where stored materials are to be preserved, restored or otherwise handled, an evaluation should be done by a professional book/records conservator. This process can be rather expensive, and may be considered for conservation of irreplaceable documents that are colonized with mold. Due to the cost of book conservation, disposal or replacement of moldy materials may be the most economically feasible option.

In order to address the conditions described in this assessment, the recommendations to be made to improve indoor air quality in this building are divided into short-term and long-term corrective measures. The short-term recommendations can be implemented as soon as practicable. Long-term measures are more complex and will require planning and resources to adequately address the overall indoor air quality concerns within the building. In view of the findings at the time of this visit, the following **short-term** measures should be considered:

1. Implement previous recommendations detailed in the DOS report, however further consideration should be given to waterproofing the foundation walls in the basement.
2. Continue with plans to employ a consultant to characterize the extent of possible mold contamination to GW above the ceiling plenums and elevator foyer columns.
3. Continue with efforts to clean ductwork of possible bird waste. This effort will also remove potential microbial-related dust/pollutants from possible mold distribution by the HVAC system.
4. Continue with plans to remediate the elevator shaft water accumulation. Prior to the release of this report, RMR reported that a mason was contacted to repair the masonry in the base of the elevator shaft. RMR also reported that a drain in the elevator floor was located and cleared of clogs.

5. Lynn school officials report that RMR identified the leak in the roof of the elevator penthouse (see Picture 13) as a possible continued source of water that is staining ceiling tiles in the 6th floor foyer. Efforts are in progress to remediate this leak.
6. Continue with efforts to separate the building's HVAC system from the basement record storage area.
7. Remove leaking batteries from the basement.
8. Examine each fresh air diffuser for function. Survey offices to ascertain if an adequate air supply exists for each room.
9. Consider having the systems balanced by an HVAC engineering firm.
10. Seal all abandoned pipes entering into the basement from the outdoors. Seal all pipe, conduit and other penetrations through the basement ceiling that penetrate into the 1st floor office space.
11. Clean debris from the interceptor drain in the basement floor.
12. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
13. Replace mold colonized pipe insulation.

The following **long-term measures** should be considered:

1. Consider removing/sealing the turbine exhaust vents on the roof if their purpose was rendered obsolete.
2. Removal of the water damaged GW above the 6^{th} floor foyer should be considered. Consult a building engineer as to what materials may be used other than GW to provide fire resistance.
3. Consult a building engineer to examine options for repairing the seal in the granite exterior wall system. Repairs may include replacement of damaged slabs.
4. Consult a building engineer as to the best method for preventing or minimizing water penetration through the foundation.
5. Repair/replace windows that are inoperable or difficult to open.

References

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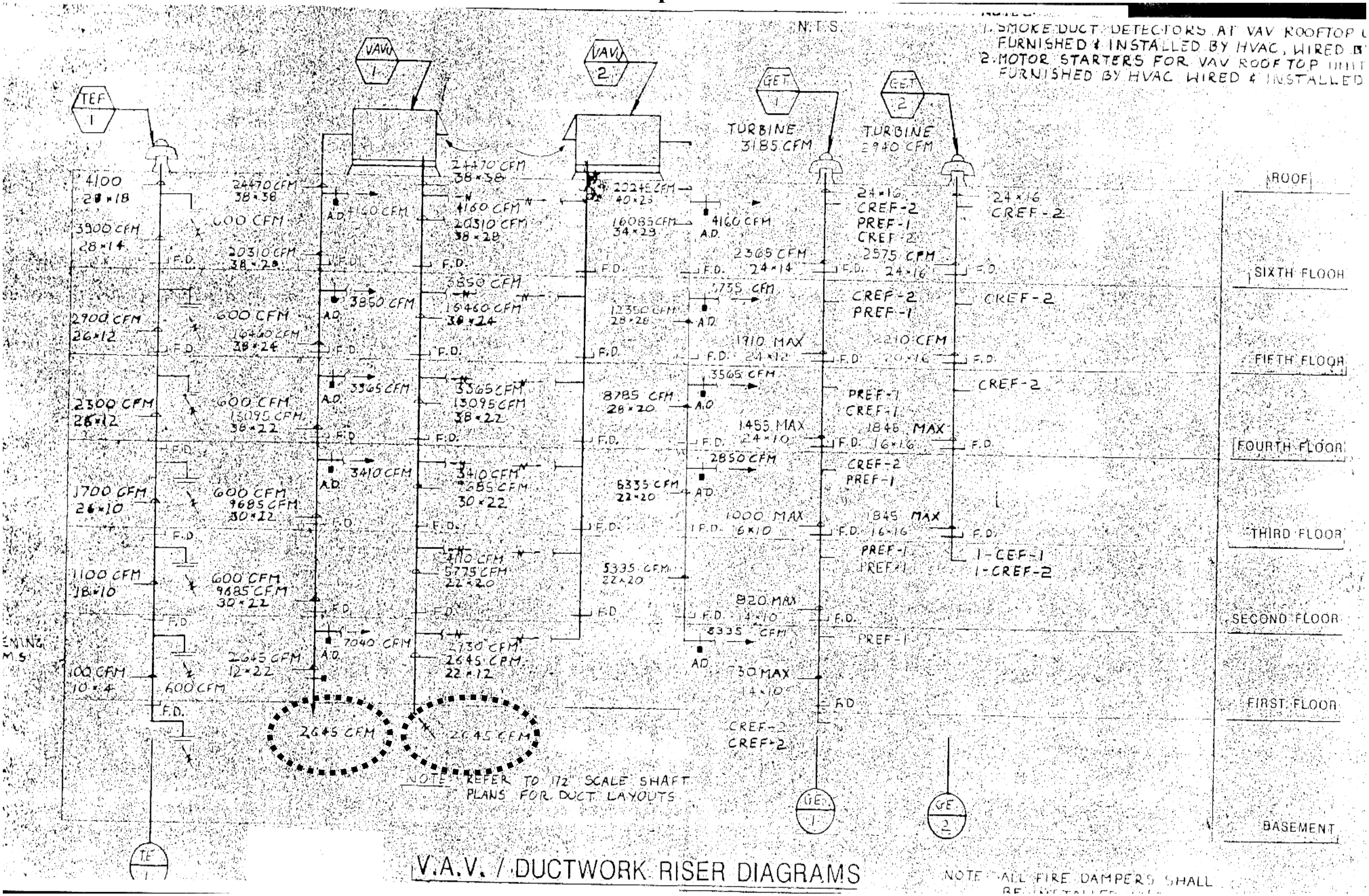
SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

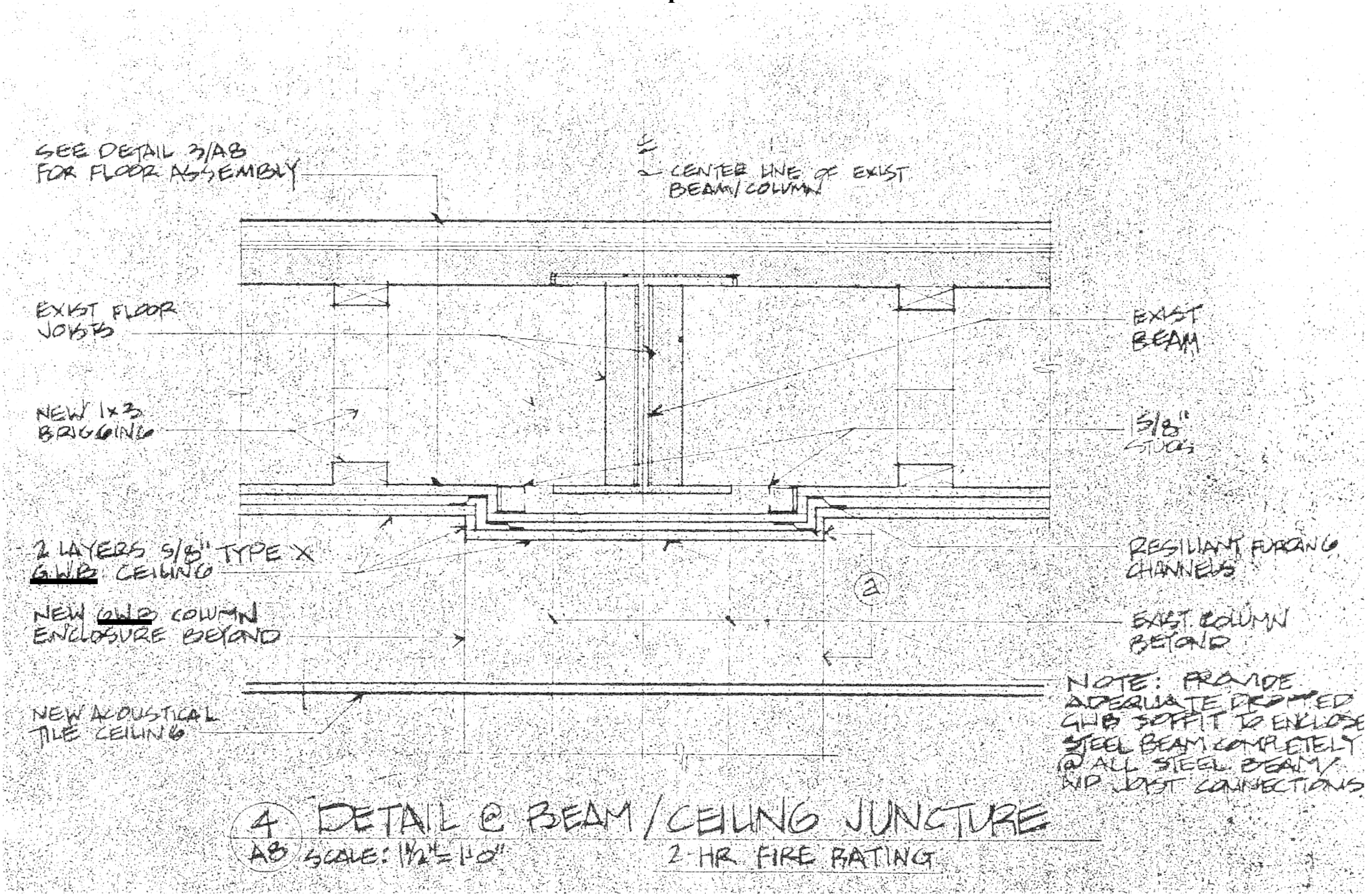
US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001.

Blueprint 1



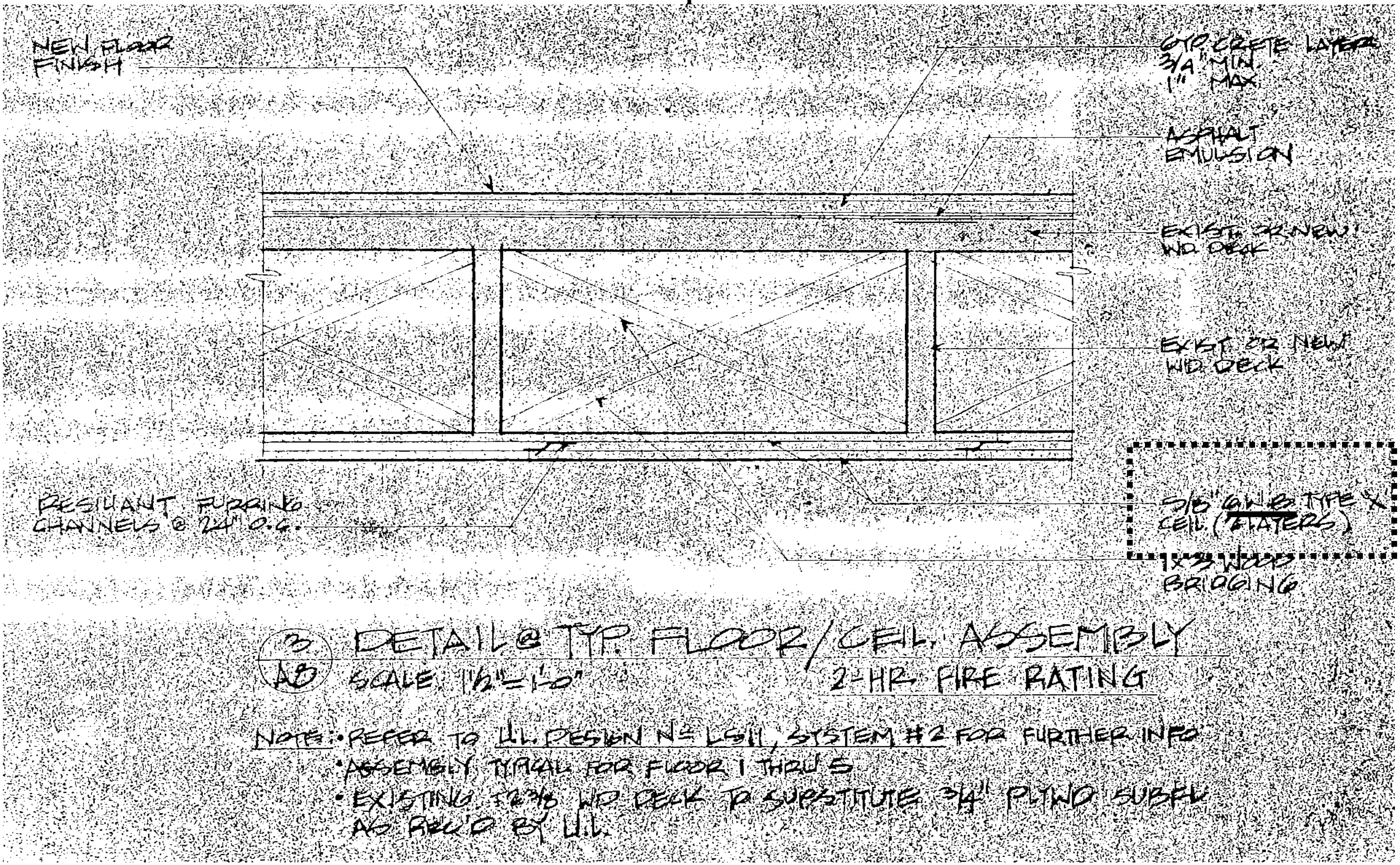
Blueprint Indicating Basement Connection to Main HVAC System Ductwork

Blueprint 2



Detail of Beam/Ceiling Junction. Note use of GW above Acoustical Ceiling Tiles
GWB on Blueprint = Gypsum Wallboard

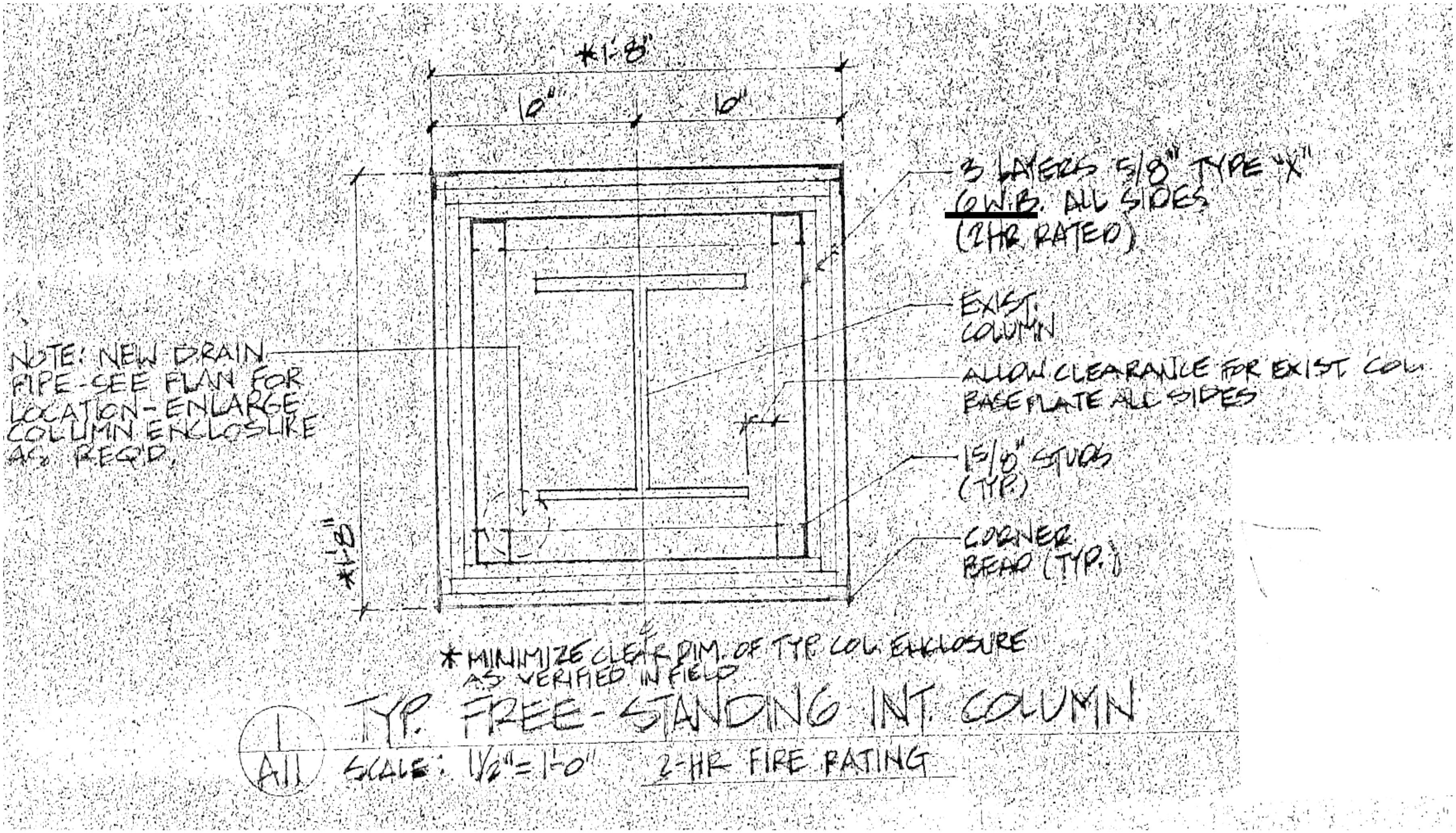
Blueprint 3



Detail of Wall Assembly. Note use of GW to Provide "2-Hr Fire Rating"

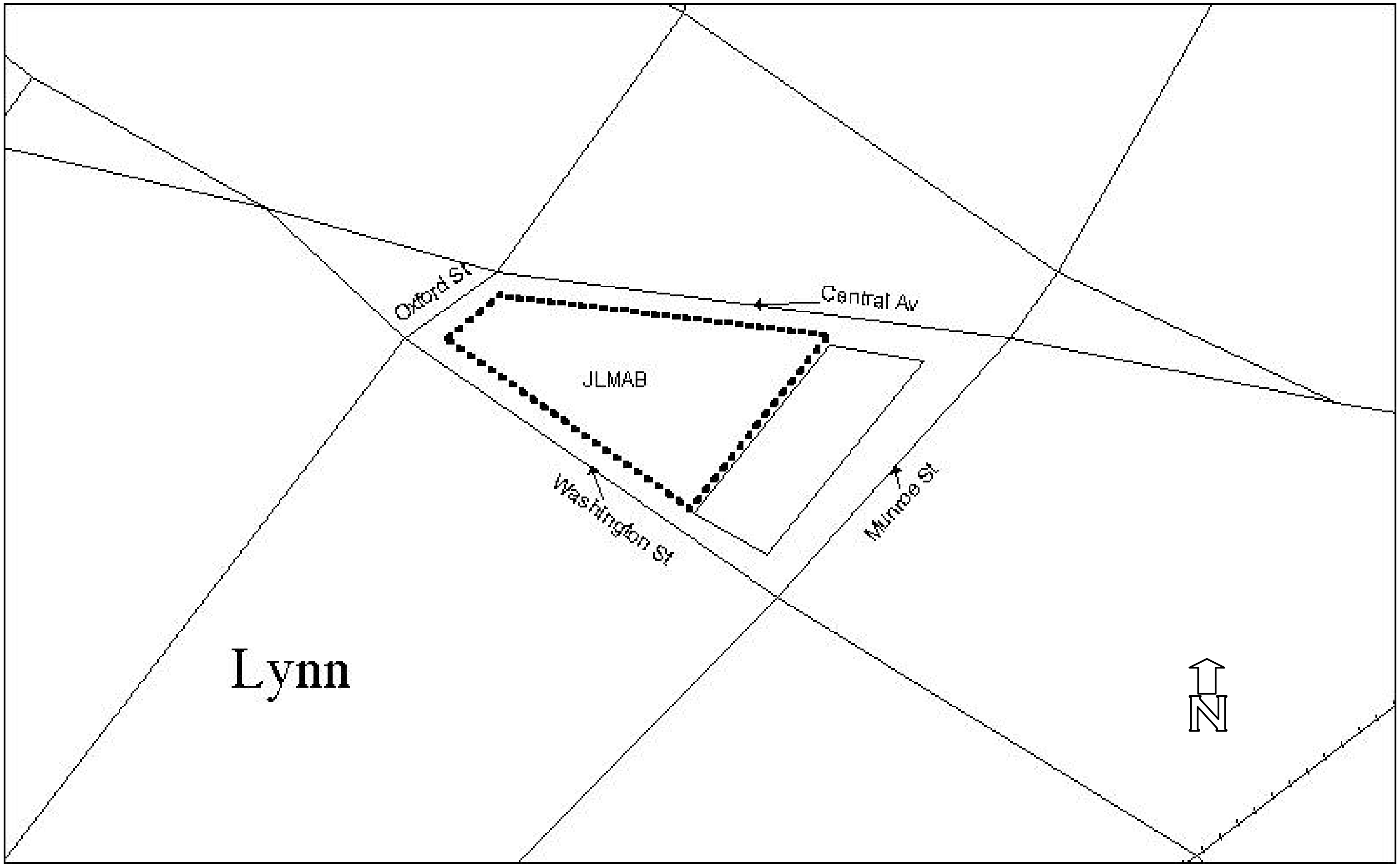
GWB on Blueprint = Gypsum Wallboard

Blueprint 4



Detail of Pillar Assembly in Elevator Foyer. Note use of GW to Provide "2-Hr [Fire} Rating"
GWB on Blueprint = Gypsum Wallboard

Map



Footprint of the JLMAB in downtown Lynn
(Map not to scale)

Picture 1

Air Diffusers Have Louvers Directed Downwards

Picture 2

Seams of Joined GW in the Ceiling Plenum.
Note Blackened Area Which May Indicate Mold Growth

Picture 3

Original Redbrick Above the First Floor

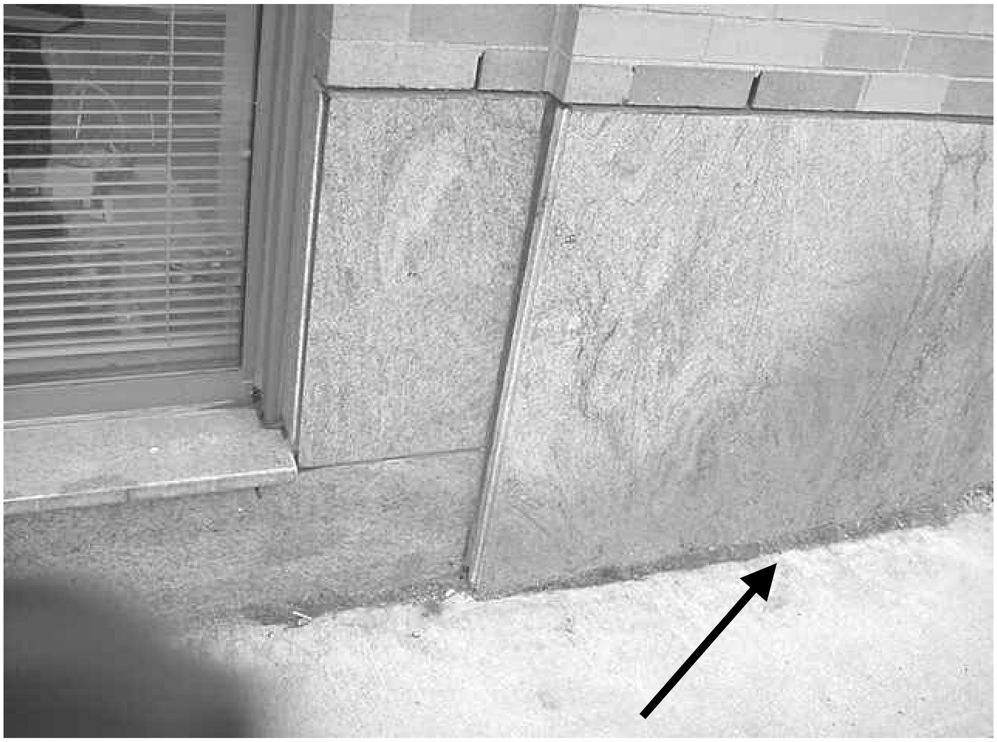
Picture 4

Red Granite Exterior Wall

Picture 5

Shrunken Sealant Material between Red Granite Slabs

Picture 5A

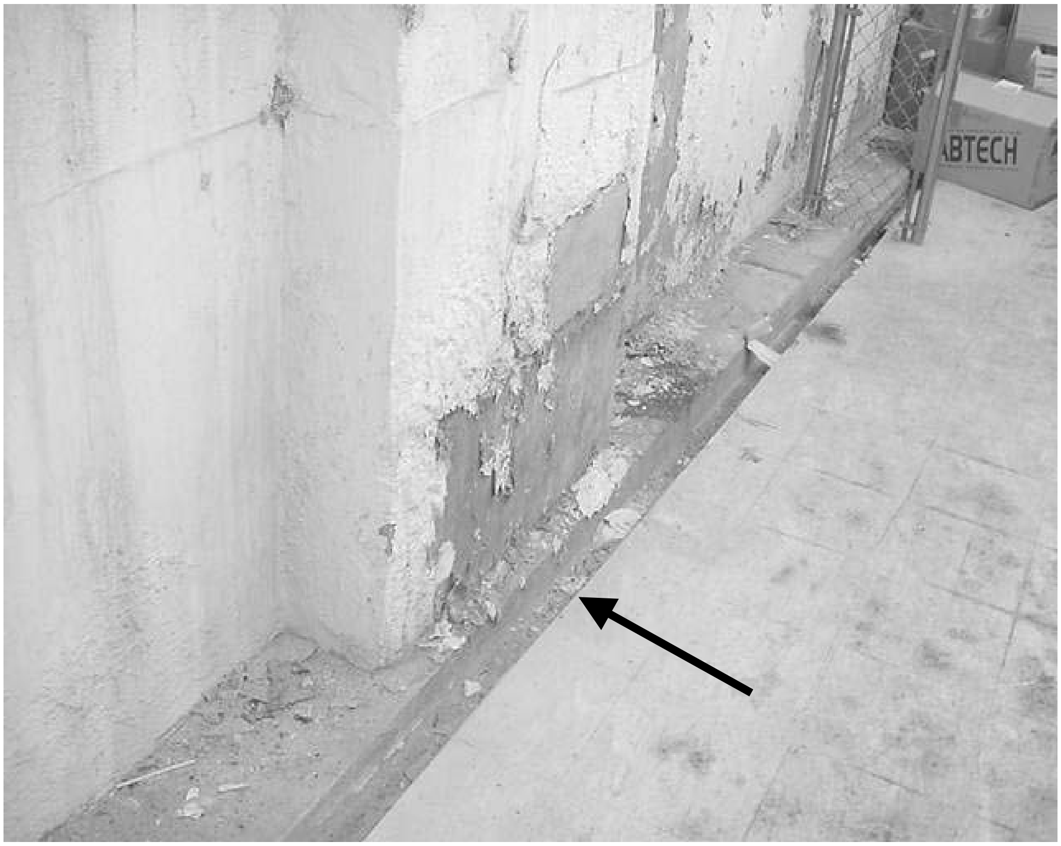


Moss on Sidewalk/Granite Slab Sealant

Picture 5B

Broken Granite Slab Exterior Panel

Picture 6



Trench in Basement Floor. Note Peeling Paint on Foundation Wall

Picture 7

Trench in Basement. Note Accumulated Debris in Trench and Multiple Water Stain Lines on GWB

Picture 8

Mold Colonized Pipe Insulation in the Basement

Picture 9

Penetration in Basement Ceiling, Which was Sealed by RMR Consultant

Picture 10

Penetrations into Basement Ceiling

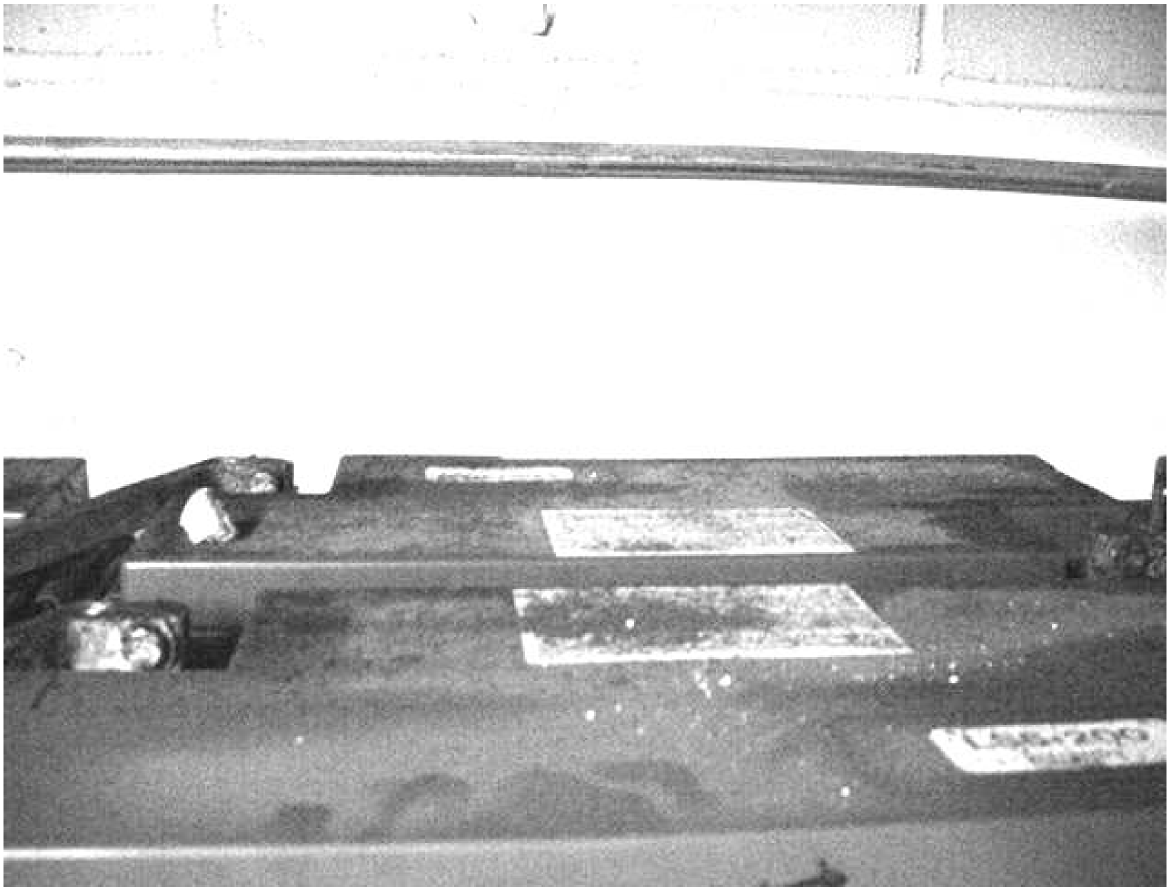
Picture 11

Turbine Vent on Roof

Picture 12

Batteries in Basement Telephone Room

Picture 12A



Rust From Corrosion on Top of Batteries

Picture 13

Elevator Penthouse on Roof

TABLE 1

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation Intake	Ventilation Exhaust	Remarks
Outside (Background)	361	45	27					
Paula's Office	494	71	28	1	No	Yes	Yes	Complaints-uneven temperatures/cold in morning, 4 water damaged CT-flaking
Mary's/Kim's Office	411	72	28	1	No	Yes	Yes	Complaints of headaches/migraines/fatigue, heavy dust accumulation on flat surfaces, stuffiness, fan covered with dust, 1 water damaged CT
Janet's Office	479	75	26	2	No	Yes	Yes	Broken window, dust accumulation @ baseboard/flat surfaces
Women's Restroom					No	No	Yes	Reports of frequent sewer gas odors
Men's Restroom					No	No	Yes	Floor drain broken (not secure)
Principal's Office	1040	75	31	3	No	Yes	Yes	

*** ppm = parts per million parts of air**
CT = ceiling tiles
GWB = gypsum wallboard

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 102	680	75	28	0	No		Yes	10 occupants gone ~10 min., dry erase board
Storage Room	668	74	31	2	No	Yes	No	20+ plants, potting soil
Room 101	1007	73	30	7	No	Yes	No	
Science Room	1325	75	32	15	No	Yes	No	Exhaust in hallway
Cafeteria/Meeting Room	628	74	28	4	No	Yes	Yes	Potting soil on vent, items blocking return vent
Computer Room	621	73	27	3	No	Yes	No	5 computers
Director's Office	517	76	27	0	No	Yes	No	
Room 103	669	73	28	8	No	Yes	No	Items on vents
Staff Development – Mazareas	481	69	31	0	No	Yes	Yes	Currently being used for storage, recent plumbing leak-CT changed
Staff Development – Dona/Rupali	583	72	30	2	No	Yes	Yes	Difficult to open

*** ppm = parts per million parts of air**
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TABLE 3

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Poska	495	74	28	0	Yes	Yes	Yes	Water cooler on carpet, 1 window doesn't open/1 window doesn't stay open
Computer Room	480	74	27	0	No	Yes	No	Dusty, odors
Teacher Training Room	460	74	26	0	Yes	Yes	Yes	Missing CT
Supply Room	456	74	26	0	No	Yes	Yes	
Conference Room	518	76	26	0	Yes	Yes	Yes	Window reportedly don't open
Teachers' Workroom	486	75	25	0	Yes	Yes	Yes	2 lamination machines, 2 photocopiers, odors/heat
Technology Room	440	71	26	0	Yes	Yes	Yes	Missing CT, reported sewer gas odors-"fairly frequently"
Credit Union	604	72	28	1	No	Yes		
Federal	425	72	27	4	Yes	Yes	Yes	Windows difficult to open

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CT = ceiling tiles
GWB = gypsum wallboard

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Lentini Office	457	69	26	0	Yes	Yes	Yes	
Benson Office	420	68	28	1	Yes	Yes	Yes	Window open, hearing loss/tinnitus reported
Angela/Evelyn	488	69	30	2	Yes	Yes	Yes	Heart palpitations reported, window open
Attendance Office	476	74	26	2	Yes	Yes	Yes	Respiratory complaints, asthma-occupational
Transportation Office	477	65	36	0	No	Yes	Yes	Cold (56 ^{o} F) air from vent – strong airflow from supply vent, humidifier-empty, hole in wall around hot water pipe-baseboard heat, thermostat set to cool
Kitchen	432	68	34	0	No	No	No	Water cooler on carpet, 2 CT
Reception Area	459	69	33	0	No	Yes	Yes	
Bilingual Office	444	73	28	4	No	Yes	Yes	Uneven heating/cooling, dust accumulation on flat surfaces-complaints from staff,

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Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 5

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								stained/dislodged CT
Kate's Office	420	72	26	0	No	Yes	Yes	Thermostat-warm, dust/cobwebs on windowsill
Jen's Office	381	71	27	0	No	Yes	Yes	Access panel on wall, valves
Deputy Superintendent's Office	539	68	34	2	Yes	Yes	Yes	Door open
Grigun	522	69	33	1	Yes	Yes	Yes	Plants, door open
Upton	509	70	32	1	Yes	Yes	Yes	
Superintendent's Office	482	70	31	2	Yes	Yes	Yes	Missing CT, water cooler on carpet, door open
Superintendent's Reception Area	504	71	31	1	Yes	Yes	Yes	Plant on carpet
Koston	482	72	31	0	Yes	Yes	Yes	Door open

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Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 6

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation Intake	Ventilation Exhaust	Remarks
Orlindi	503	71	30	0	Yes	Yes	Yes	Door open
Arabino	534	71	30	2	Yes	Yes	Yes	Door open
6th Floor Lobby	553	72	32	1	No	Yes	Yes	Elevator, 2 water damaged CT, 2 missing CT, GWB above ceiling plenum
School Committee Room	503	72	31	0	No	Yes	Yes	1 water damaged CT
Bourque	524	72	31	1	No	Yes	Yes	Accumulated items, 1 water damaged CT, door open
Photocopier Room	507	73	29	0	Yes	Yes	Yes	Photocopier, door open, shredder
5th Floor Lobby	513	72	29	3	No	Yes	Yes	6 water damaged CT, GWB column
Potter	524	72	29	1	Yes	Yes	Yes	Window and door open
Driscoll	488	72	29	0	Yes	Yes	Yes	Door open

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Temperature -	70 - 78 °F
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TABLE 7

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Hallway West Hall	503	72	29	1	No	Yes	Yes	
Curdo	526	71	29	0	Yes	Yes	Yes	
West Hallway near Kitchen	611	72	30	0	No	Yes	Yes	2 photocopiers
Cassidy	548	72	29	1	Yes	Yes	Yes	Door open
Allen	524	72	30	1	Yes	Yes	Yes	Supply off
Foy/Stone	621	73	30	1	Yes	Yes	Yes	Door open
Zeyn	517	73	29	0	Yes	Yes	Yes	1 missing CT, door open
Spencer	563	73	29	2	Yes	Yes		Door open
Howell	539	73	29	0	Yes	Yes	Yes	Plants, door open
Rojas	519	72	29	0	Yes	Yes	Yes	Door open

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Relative Humidity -	40 - 60%

TABLE 8

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Kelley	510	72	29	0	Yes	Yes	Yes	
4th Floor Lobby	609	73	29	3	No	Yes	Yes	3 photocopiers, elevator, 5 water damaged CT
Desilets	597	73	29	3	No	Yes	Yes	
Libby	652	72	30	1	Yes	Yes	Yes	1 water damaged CT
Nugent	632	74	30	2	Yes	Yes	Yes	Supply off, door open
Break Room	570	77	29	0	Yes	Yes	Yes	Soda machine, door open
Personnel	565	74	20	2	Yes	Yes	Yes	Door open
West Hallway	584	74	28	1	Yes	Yes	Yes	
SW Corner Hallway	555	74	27	1	Yes	Yes	Yes	Plants, photocopier
Maintenance	509	73	27	1	Yes	Yes	Yes	Door open

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Relative Humidity -	40 - 60%

TABLE 9

Indoor Air Test Results – Lynn School Department Administration Building, 14 Central Ave., Lynn, MA – December 18, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Guidira	585	74	28	1	Yes	Yes	Yes	Door open
MacFarland	561	73	28	1	Yes	Yes	Yes	Door open
LeBlanc	603	73	28	2	Yes	Yes	Yes	Door open
Fee	506	72	29	0	Yes	Yes	Yes	Door open

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Temperature -	70 - 78 °F
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